

2007 Groundfish Assessment Review Meeting
Working Paper 3F**Movement-Mortality Analyses of Yellowtail Flounder Tagging Data**

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Abstract

The objective of this working paper is to provide updated analytical results from the cooperative yellowtail tagging study and demonstrate potential utility of the data for future stock assessments (TOR C). However, the tagging study is still in progress and these data are preliminary. More importantly, these analyses are presented to illustrate developmental methods and are not intended for stock assessment purposes. Background and introductory information about the yellowtail flounder tagging study are described in GARM Working Paper 3E.

Movement-Mortality Model

The analytical model is based on the assumption that the observed pattern of recaptures is a function of harvest rate in each area and movement among areas. If the population of tagged yellowtail is representative of the entire population, the estimates of movement and mortality will also be representative. The analytical design will relate the observed number of tag returns (r) to a predicted number of tag returns:

$$1) \quad \tilde{r}_i^t = n_i^t \beta_i^t \frac{F_i^t (1 - e^{-(F+M)})}{(F_i^t + M)}$$

and tags at the beginning of a time step is a function of abundance at the beginning of the time step in all areas, movement to the area (or residence in the area) and survival in the area:

$$2) \quad n_i^{t+1} = \sum_j \alpha_{ij}^t S_j^t n_j^t$$

where

n_j^t is the number of tags present in area j at time t

β_i^t is the reporting rate in area i at time t .

F_i^t is the fishing mortality rate in area i at time t .

M is the natural mortality rate

$\alpha_{i,j}^t$ is the proportion of tags in area j that move to area i at time t

S_i^t is the survival in area i at time t [$S=e^{-(M+F)}$]

The parameter β_i^t can be calculated as the ratio of lottery tag returns to high value (\$100) tag returns, assuming that all recaptures if \$100 tags are reported. The parameters $\alpha_{i,j}^t$ (movement) and F_i^t (fishing mortality) can be estimated to fit model predictions to the observed frequency of seasonal returns by area. In the most aggregated form of the model, the movement matrix among the three stock (Cape Cod-Gulf of Maine, Georges Bank and southern New England-Mid Atlantic) areas is:

$$3) \quad \begin{bmatrix} \alpha_{CCGOM} & \alpha_{CCGOM,GB} & \alpha_{CCGOM,SNEMA} \\ \alpha_{GB,CCGOM} & \alpha_{GB} & \alpha_{GB,SNEMA} \\ \alpha_{SNEMA,CCGOM} & \alpha_{SNEMA,GB} & \alpha_{SNEMA} \end{bmatrix} = A$$

where diagonal elements are the proportion of yellowtail that remain in the area of release, off-diagonal elements are movement rates between stock areas, and rows sum to one. Therefore, residence rates (diagonal elements) can be calculated from the two movement rates (off-diagonal elements in the same row).

The number of tag returns and the duration of the study will dictate how many parameters can be reliably estimated. The model has flexible spatiotemporal resolution, so that stock areas can be analyzed by statistical areas, and movements can be analyzed by season, if the number of tag returns supports such detail.

For the purposes of model development, a simple 9-parameter model (a fishing mortality rate and two movement coefficients for each of the three stock areas) was initially developed using a monthly time step, but the time step was expanded to quarterly based on initial peer review. Starting values were based on current fishing mortality estimates from the most recent stock assessments, and proportional movement from previous tagging studies (GARM WP 3E). Model residuals were used to explore deviation of observed recaptures from expectations using starting values of model parameters.

According to the experimental design of tag releases, the model application treats each series of releases in each stock area in each year as a release event, because the tag releases from each series of trips was designed to represent the geographic distribution of each stock. Successive addition of releases over several months was accounted for by adding new releases (n_r) to the expected tags at large, applying a partial month of mortality based on mean day of release (d) in the previous month:

$$4) \quad n_i^{t+1} = n_{r,i}^t e^{[(-F-M)(d/30)]} + \sum_j \alpha_{ij}^t S_j^t n_j^t$$

The number of recaptured tags with unknown area ($r_?$), adjusted by reporting rate, were also subtracted from the modeled number of tags at large:

$$5) \quad n_i^{t+1} = n_{r,i}^t e^{[(-F-M)(d/30)]} - \frac{r_i^t}{\beta} + \sum_j \alpha_{ij}^t S_j^t n_j^t$$

Recaptured tags with unknown capture date were subtracted from the initial number of tagged fish.

Interim Results

As of August 1 2007, tags from 3,618 recaptured fish were reported with up to four years at large. Eight percent of all lottery tags have been returned; 13% of \$100 reward tags and 10% of data tags were returned. The relative return rate of lottery tags to high-value tags indicates a 59% reporting rate (GARM WP3E).

Several iterations of the model were developed and reviewed at annual tagging meetings as well as the pre-GARM tagging meeting in August 2007. A summary of the review is that temporal resolution of the recapture data was not adequate to support monthly time steps, because results were sensitive to starting values and constraints. However, revising the model structure to quarterly time steps did not remedy the problem. Results from simulation suggest (GARM WP3G) suggest that the model may not perform well when true movement rates are low, because of parameter correlations between mortality and movement.

Although model explorations continue to determine optimal model structure (e.g., time-varying or constant mortality parameters), alternative objective functions (e.g., a likelihood framework), or using ancillary data (e.g., fishery catch or effort). At this time the most reliable results from the model are from a simpler model, with fewer parameters. The results documented in Appendix A use fishing mortality estimates from the most recent stock assessments, and only estimate movement parameters. The intention is to document the model and its properties as well as the general fit to the data.

Note that there are some severe residual patterns and results should be viewed as a demonstration only, and interpreted with caution. The estimates of annual movement are all less than 2%, with the maximum movement from southern New England-Mid Atlantic to Georges Bank (1.9%) and to Cape Cod-Gulf of Maine (1.0%). All other estimates of annual movement are less than 1%:

From	To			sum
	CCGOM	GB	SNEMA	
CCGOM	99.0%	0.7%	0.3%	100%
GB	0.2%	99.8%	0.0%	100%
SNEMA	1.0%	1.9%	97.1%	100%

This is one of several alternative attempts at modeling movement and mortality (listed in GARM WP 3E); results from alternative approaches may provide useful feedback for these analyses.

Appendix A. Preliminary movement analysis of yellowtail flounder tagging data.

Parameters	starting value	basis	Assumed Parameters	basis	Calculated Parameters	Annual Rates
Fg	0.2856	0.2856 TRAC 2007	M	0.0500 M=0.2	Uc	0.199 Fg
Fc	0.2278	0.2278 GARM2005	B	0.59 \$100tags	Ug	0.243 Fc
Fs	0.1925	0.1925 GARM2005			Us	0.171 Fs
Acg	0.0018	0.0008 historical average			Sc	0.757 Acg
Acs	0.0007	0.0027 historical average			Sg	0.715 Acs
Agc	0.0004	0.0000 historical average			Ss	0.785 Agc
Ags	0.0001	0.0072 historical average			Acc	0.998 Ags
Asc	0.0025	0.0024 historical average			Agg	0.999 Asc
Asg	0.0048	0.0060 historical average			Ass	0.993 Asg
(quarterly rates)						
						Acc
						Agg
						Ass

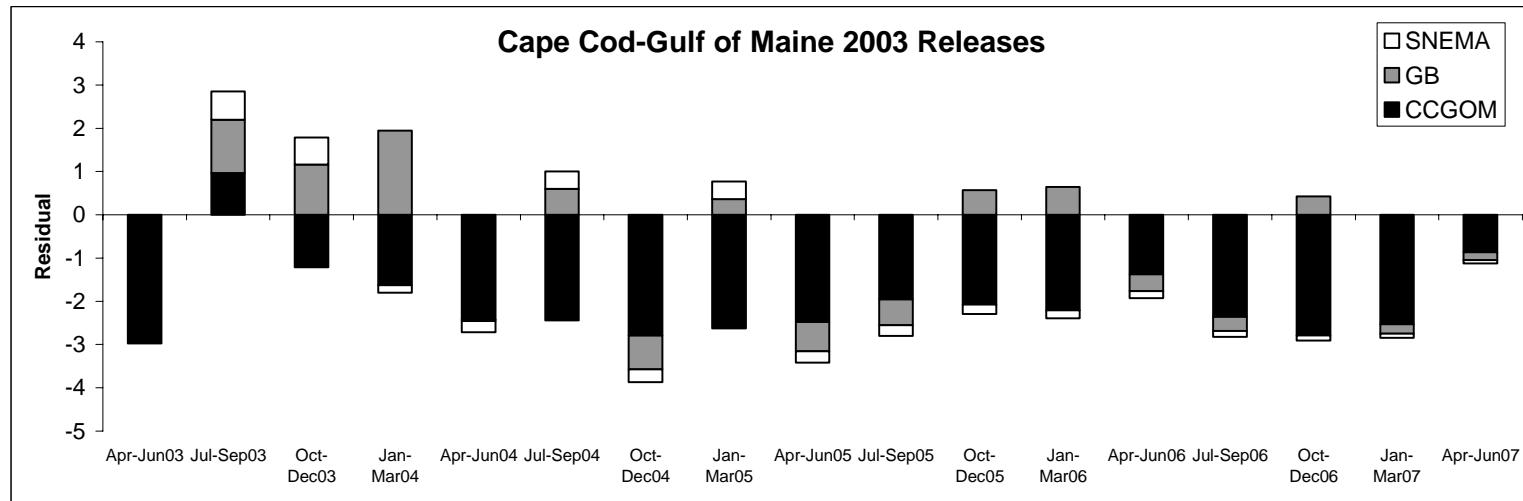
Release Events

Stock	Year	Tags	Recaptures	%recapture	RSS	RMS	Partial Variance
CCGOM	2003	4334	524	12.1%	93	1.8	10%
GB	2003	4163	557	13.4%	56	1.2	6%
SNEMA	2003	815	3	0.4%	125	2.8	14%
CCGOM	2004	2751	155	5.6%	72	1.8	8%
GB	2004	14532	1082	7.4%	114	2.7	13%
SNEMA	2004	1719	75	4.4%	125	3.2	14%
CCGOM	2005	1105	106	9.6%	36	1.3	4%
GB	2005	4590	495	10.8%	86	2.9	10%
SNEMA	2005	547	3	0.5%	74	3.1	8%
CCGOM	2006	2942	282	9.6%	19	1.3	2%
GB	2006	4751	264	5.6%	21	1.4	2%
SNEMA	2006	1791	12	0.7%	84	5.6	9%
Sum		44040	3558	8.1%	906	7.8	100%

Release Event: Cape Cod-Gulf of Maine 2003

RSS 93.3463
RMS 1.83032

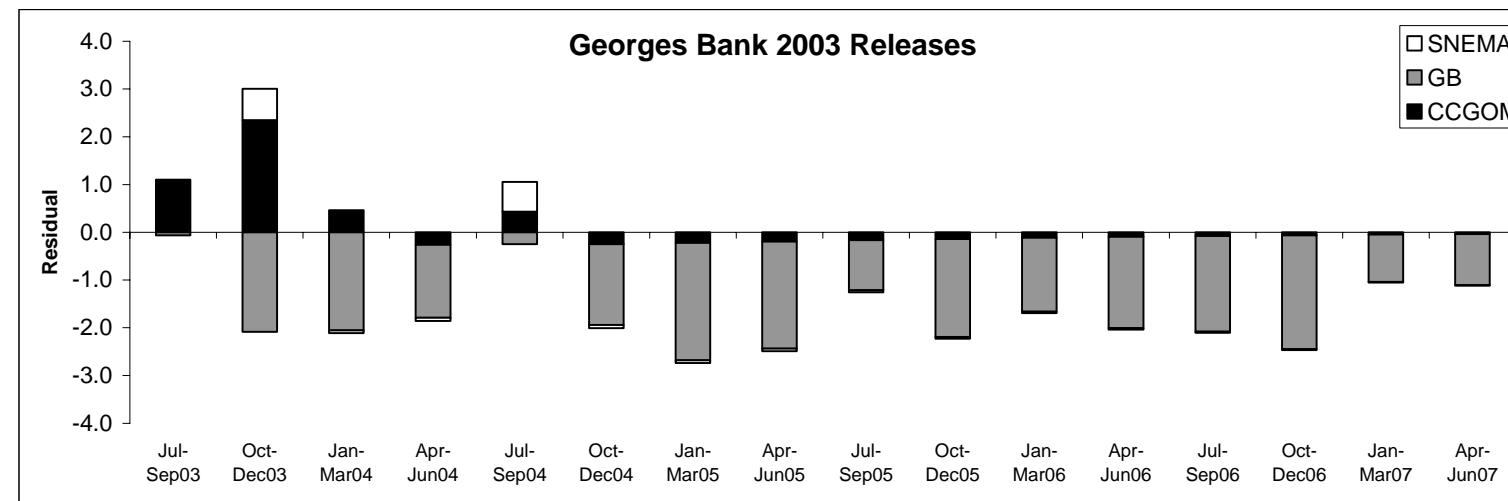
Month	Releases	Mean Date	Recaptures					Predicted Tags at Large					Predicted Recaptures					Residuals			
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total		
Apr-Jun03	878	84	4	0	0	0	4	873	0	0	873	97	0	0	97	-3	0	0	0	-3	
Jul-Sep03	2459	32	210	3	1	3	217	673	1	0	675	79	0	0	79	1	1	1	1	3	
Oct-Dec03	997	49	95	3	1	13	112	2733	2	1	2735	321	0	0	321	-1	1	1	1	1	
Jan-Mar04			66	11	0	1	78	2899	5	2	2906	340	1	0	341	-2	2	0	0	0	
Apr-Jun04			22	1	0	2	25	2189	8	3	2199	257	1	0	258	-2	0	0	0	-3	
Jul-Sep04			16	3	1	1	21	1651	8	3	1662	194	1	0	195	-2	1	0	0	-1	
Oct-Dec04			8	0	0	5	13	1246	8	3	1257	146	1	0	148	-3	-1	0	0	-4	
Jan-Mar05			7	2	1	0	10	933	8	3	944	109	1	0	111	-3	0	0	0	-2	
Apr-Jun05			6	0	0	0	6	705	7	3	715	83	1	0	84	-2	-1	0	0	-3	
Jul-Sep05			8	0	0	2	10	533	6	3	541	62	1	0	64	-2	-1	0	0	-3	
Oct-Dec05			5	2	0	0	7	399	5	2	406	47	1	0	48	-2	1	0	0	-2	
Jan-Mar06			3	2	0	0	5	302	4	2	308	35	1	0	36	-2	1	0	0	-2	
Apr-Jun06			6	0	0	0	6	228	3	2	233	27	0	0	27	-1	0	0	0	-2	
Jul-Sep06			1	0	0	0	1	172	3	1	176	20	0	0	21	-2	0	0	0	-3	
Oct-Dec06			0	1	0	0	1	130	2	1	133	15	0	0	16	-3	0	0	0	-2	
Jan-Mar07			0	0	0	1	1	98	2	1	101	12	0	0	12	-3	0	0	0	-3	
Apr-Jun07			3	0	0	0	3	73	1	1	75	9	0	0	9	-1	0	0	0	-1	
unknown			1			3	4														
Total	4334		461	28	4	31	524					sum	1852	10	3	1866	-34	4	0	-30	



Release Event: Georges Bank 2003

RSS 56.3654
RMS 1.17428

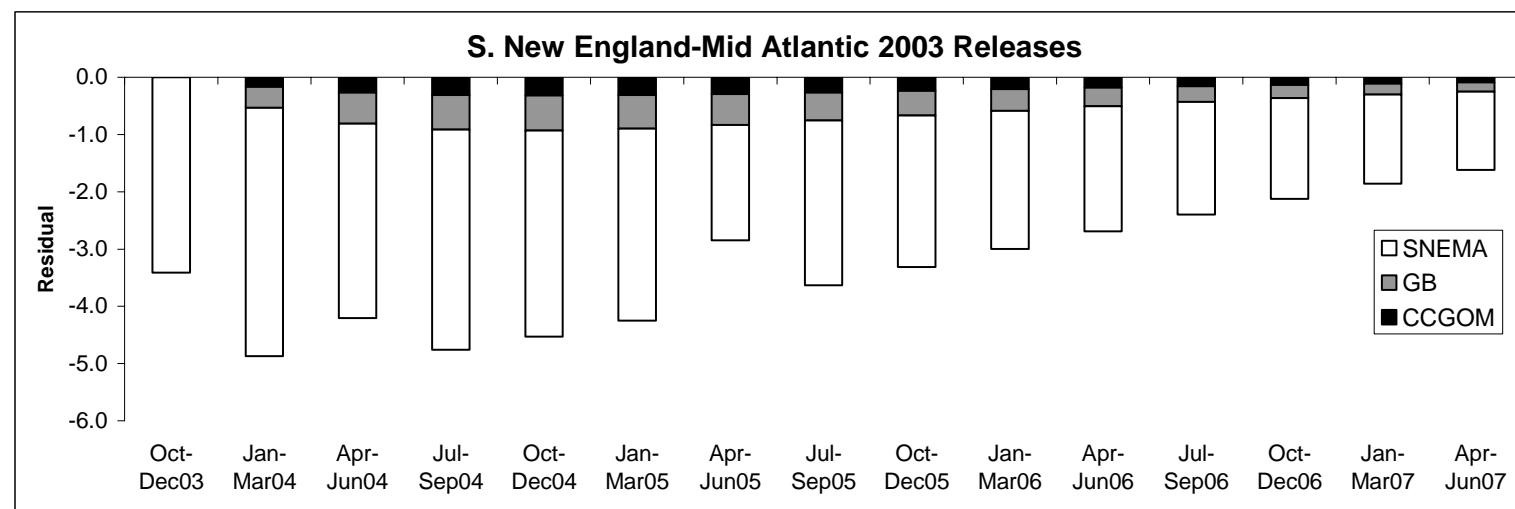
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			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	
Jul-Sep03	4163	13	2	93	0	0	95	0	4139	0	4139	0	99	0	99	1	0	0	0	-1	-1	-1	
Oct-Dec03			11	70	1	3	85	1	3975	0	3977	0	569	0	569	2	-2	1	1	-1	-1	-1	
Jan-Mar04			1	51	0	3	55	2	2835	1	2838	0	406	0	406	0	-2	0	0	-2	0	-2	
Apr-Jun04			0	62	0	2	64	3	2021	1	2024	0	289	0	290	0	-2	0	0	-2	0	-2	
Jul-Sep04			1	161	1	4	167	3	1440	1	1444	0	206	0	207	0	0	0	1	0	1	0	
Oct-Dec04			0	26	0	1	27	2	1022	1	1025	0	146	0	147	0	-2	0	0	-2	0	-2	
Jan-Mar05			0	8	0	1	9	2	729	1	731	0	104	0	105	0	-2	0	0	-2	0	-2	
Apr-Jun05			0	7	0	0	7	2	519	1	521	0	74	0	75	0	-2	0	0	-2	0	-2	
Jul-Sep05			0	18	0	0	18	2	371	0	373	0	53	0	53	0	-1	0	0	-1	0	-1	
Oct-Dec05			0	4	0	0	4	1	265	0	267	0	38	0	38	0	-2	0	0	-2	0	-2	
Jan-Mar06			0	5	0	0	5	1	189	0	191	0	27	0	27	0	-2	0	0	-2	0	-2	
Apr-Jun06			0	2	0	0	2	1	135	0	136	0	19	0	19	0	-2	0	0	-2	0	-2	
Jul-Sep06			0	1	0	0	1	1	97	0	98	0	14	0	14	0	-2	0	0	-2	0	-2	
Oct-Dec06			0	0	0	0	0	1	69	0	70	0	10	0	10	0	-2	0	0	-2	0	-2	
Jan-Mar07			0	2	0	1	3	0	49	0	50	0	7	0	7	0	-1	0	0	-1	0	-1	
Apr-Jun07			0	1	0	0	1	0	34	0	34	0	5	0	5	0	-1	0	0	-1	0	-1	
unknown							14	14															
Total	4163			15	511	2	29	557					3	2068	1	2071	3	-25	1	-24			



Release Event: Southern New England-Mid Atlantic 2003

RSS 125.415
RMS 2.787

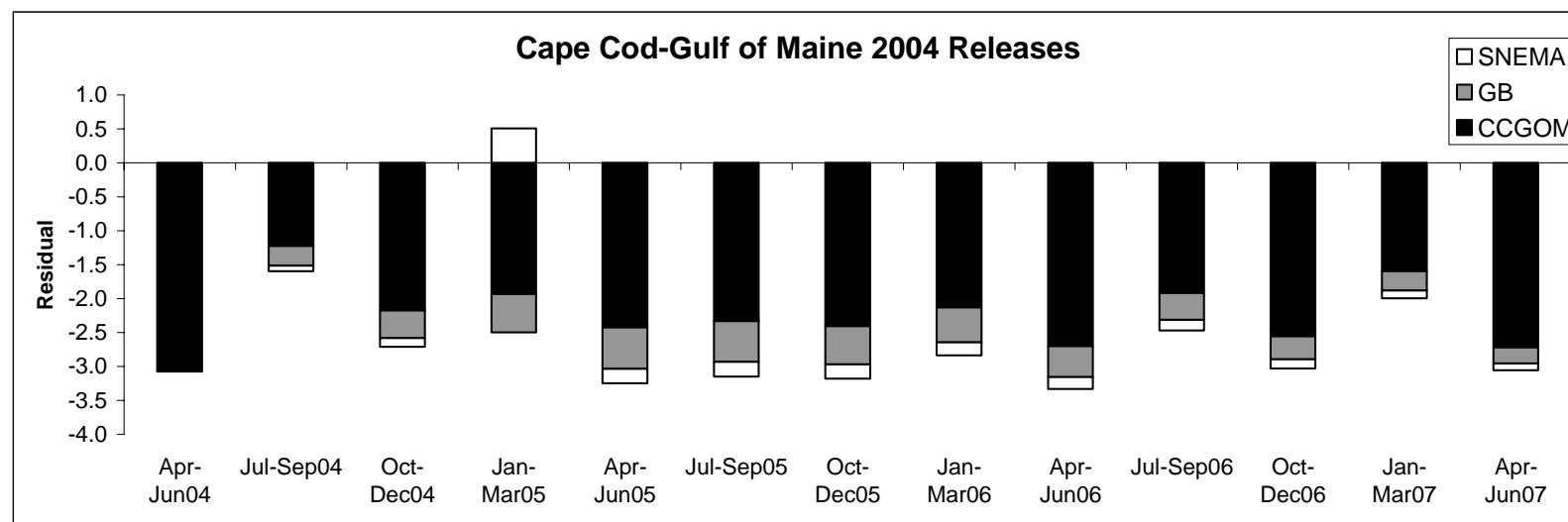
Month	Releases	Mean Date	Recaptures					Predicted Tags at Large				Predicted Recaptures				Residuals			
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total
Oct-Dec03	815	30	0	0	0	0	0	0	0	815	815	0	0	29	29	0	0	-3	-3
Jan-Mar04			0	0	0	0	0	2	3	744	749	0	0	75	76	0	0	-4	-5
Apr-Jun04			0	0	1	0	1	3	5	579	587	0	1	58	59	0	-1	-3	-4
Jul-Sep04			0	0	0	0	0	3	6	451	460	0	1	46	47	0	-1	-4	-5
Oct-Dec04			0	0	0	0	0	3	6	352	361	0	1	35	37	0	-1	-4	-5
Jan-Mar05			0	0	0	0	0	3	6	274	282	0	1	28	29	0	-1	-3	-4
Apr-Jun05			0	0	2	0	2	3	5	213	221	0	1	22	23	0	-1	-2	-3
Jul-Sep05			0	0	0	0	0	3	4	166	173	0	1	17	18	0	0	-3	-4
Oct-Dec05			0	0	0	0	0	2	4	129	135	0	1	13	14	0	0	-3	-3
Jan-Mar06			0	0	0	0	0	2	3	101	106	0	0	10	11	0	0	-2	-3
Apr-Jun06			0	0	0	0	0	2	3	79	83	0	0	8	8	0	0	-2	-3
Jul-Sep06			0	0	0	0	0	1	2	61	65	0	0	6	7	0	0	-2	-2
Oct-Dec06			0	0	0	0	0	1	2	48	51	0	0	5	5	0	0	-2	-2
Jan-Mar07			0	0	0	0	0	1	1	37	40	0	0	4	4	0	0	-2	-2
Apr-Jun07			0	0	0	0	0	1	1	29	31	0	0	3	3	0	0	-1	-2
unknown			0																
Total	815		0	0	3	0	3					3	7	358	369	-3	-6	-41	-49



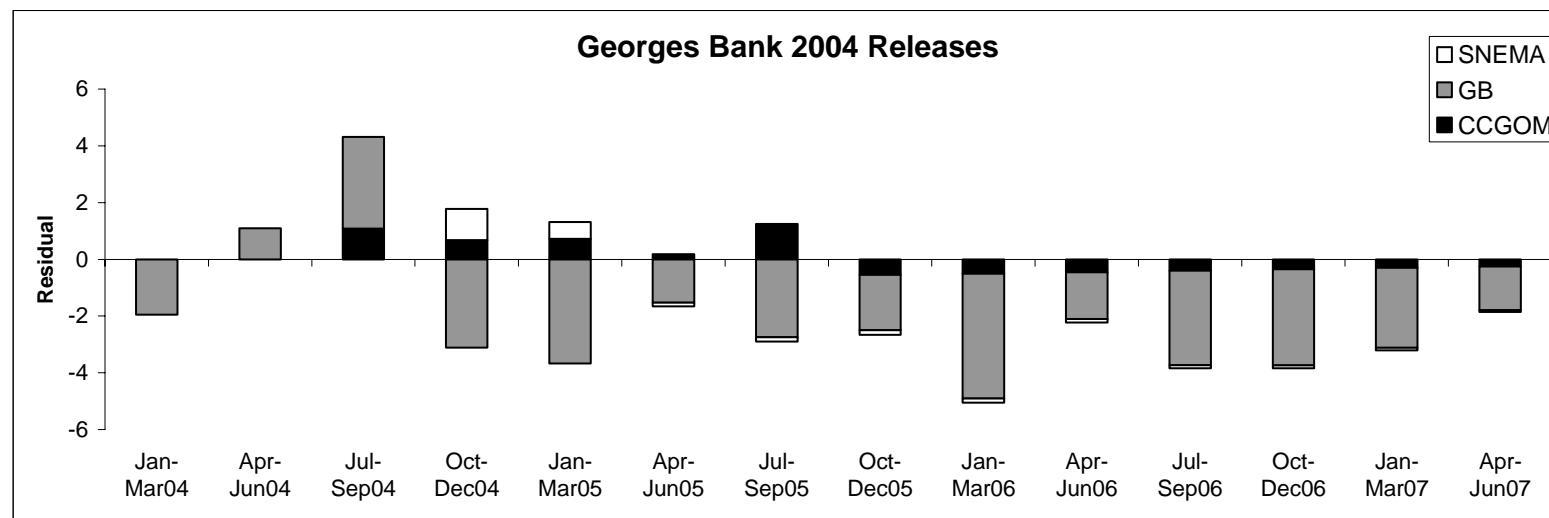
Release Event: Cape Cod-Gulf of Maine 2004

RSS 71.5869
RMS 1.83556

Month	Releases	Mean Date	Recaptures					Predicted Tags at Large					Predicted Recaptures					Residuals			
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total		
Apr-Jun04	1712	76	7	0	0	0	7	1712	0	0	1712	172	0	0	172	-3	0	0	0	-3	
Jul-Sep04	1039	14	46	0	0	1	47	1356	2	1	1359	159	0	0	159	-1	0	0	0	-2	
Oct-Dec04			26	0	0	1	27	2016	4	1	2021	237	1	0	237	-2	0	0	0	-3	
Jan-Mar05			25	0	1	0	26	1522	5	2	1529	179	1	0	180	-2	-1	1	1	-2	
Apr-Jun05			11	0	0	0	11	1150	6	2	1158	135	1	0	136	-2	-1	0	0	-3	
Jul-Sep05			9	0	0	2	11	869	6	2	877	102	1	0	103	-2	-1	0	0	-3	
Oct-Dec05			6	0	0	0	6	653	5	2	661	77	1	0	78	-2	-1	0	0	-3	
Jan-Mar06			6	0	0	0	6	494	5	2	500	58	1	0	59	-2	-1	0	0	-3	
Apr-Jun06			2	0	0	0	2	373	4	2	379	44	1	0	45	-3	0	0	0	-3	
Jul-Sep06			4	0	0	1	5	282	3	2	287	33	0	0	34	-2	0	0	0	-2	
Oct-Dec06			1	0	0	0	1	211	3	1	216	25	0	0	25	-3	0	0	0	-3	
Jan-Mar07			3	0	0	0	3	160	2	1	163	19	0	0	19	-2	0	0	0	-2	
Apr-Jun07			0	0	0	0	0	121	2	1	124	14	0	0	15	-3	0	0	0	-3	
unknown			1		2	3															
Total	2751		147	0	1	7	155					1252	7	2	1261	-29	-5	-1	-36		



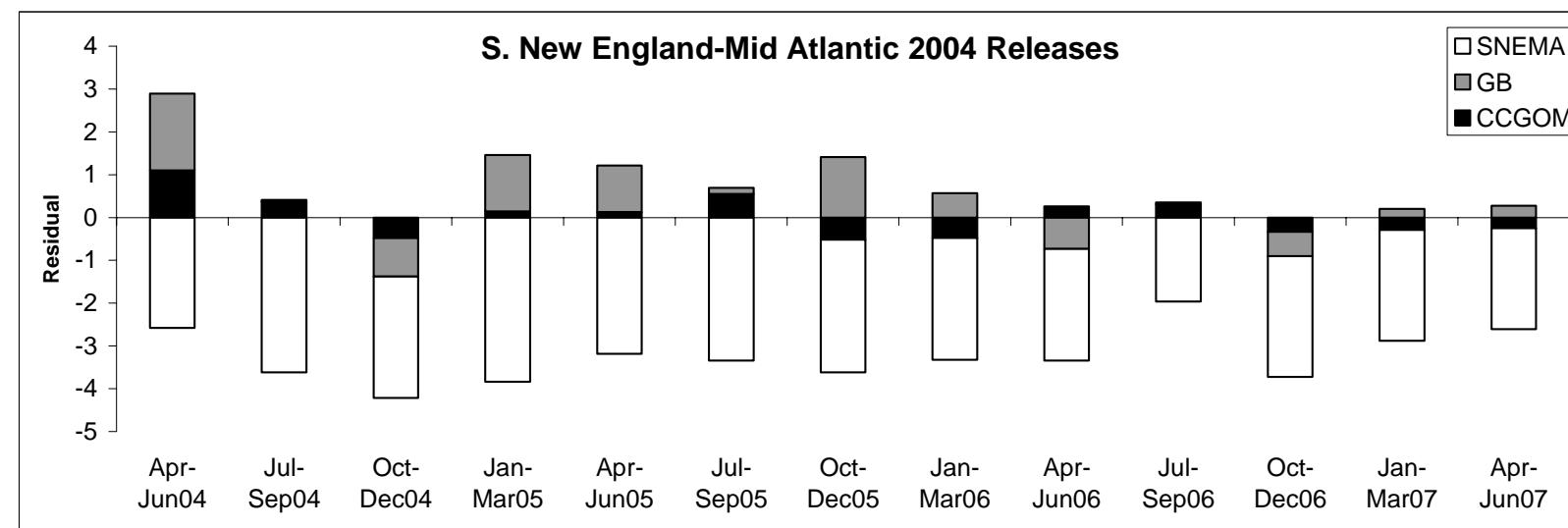
Release Event: Georges Bank 2004										RSS	113.875											
	Month	Mean Releases	Date	Recaptures					Predicted Tags at Large				Predicted Recaptures				Residuals					
				CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total		
	Jan-Mar04	188	40	0	1	0	1	2	0	188	0	188	0	13	0	13	0	-2	0	0	-2	
	Apr-Jun04			0	72	0	0	72	0	164	0	165	0	24	0	24	0	1	0	0	1	
	Jul-Sep04	14304	43	2	448	0	21	471	0	118	0	118	0	17	0	17	1	3	0	0	4	
	Oct-Dec04	40	7	1	77	2	1	81	0	12214	0	12215	0	1749	0	1749	1	-3	1	-1		
	Jan-Mar05			2	31	1	5	39	4	8764	1	8769	0	1255	0	1255	1	-4	1	-2		
	Apr-Jun05			1	194	0	9	204	6	6254	1	6261	1	895	0	896	0	-2	0	0	-1	
	Jul-Sep05			5	40	0	3	48	6	4453	2	4461	1	637	0	638	1	-3	0	0	-2	
	Oct-Dec05			0	63	0	0	63	6	3177	2	3184	1	455	0	456	-1	-2	0	0	-3	
	Jan-Mar06			0	3	0	2	5	6	2270	2	2277	1	325	0	326	-1	-4	0	0	-5	
	Apr-Jun06			0	44	0	0	44	5	1618	1	1625	1	232	0	232	0	-2	0	0	-2	
	Jul-Sep06			0	5	0	1	6	4	1156	1	1162	0	166	0	166	0	-3	0	0	-4	
	Oct-Dec06			0	3	0	4	7	4	824	1	829	0	118	0	119	0	-3	0	0	-4	
	Jan-Mar07			0	4	0	0	4	3	582	1	586	0	83	0	84	0	-3	0	0	-3	
	Apr-Jun07			0	12	0	0	12	2	416	1	419	0	60	0	60	0	-2	0	0	-2	
unknown					1		23	24														
	Total	14532			11	998	3	70	1082					5	6027	1	6034	1	-28	1	-26	



Release Event: Southern New England-Mid Atlantic 2004

RSS
RMS
125.381
3.21491

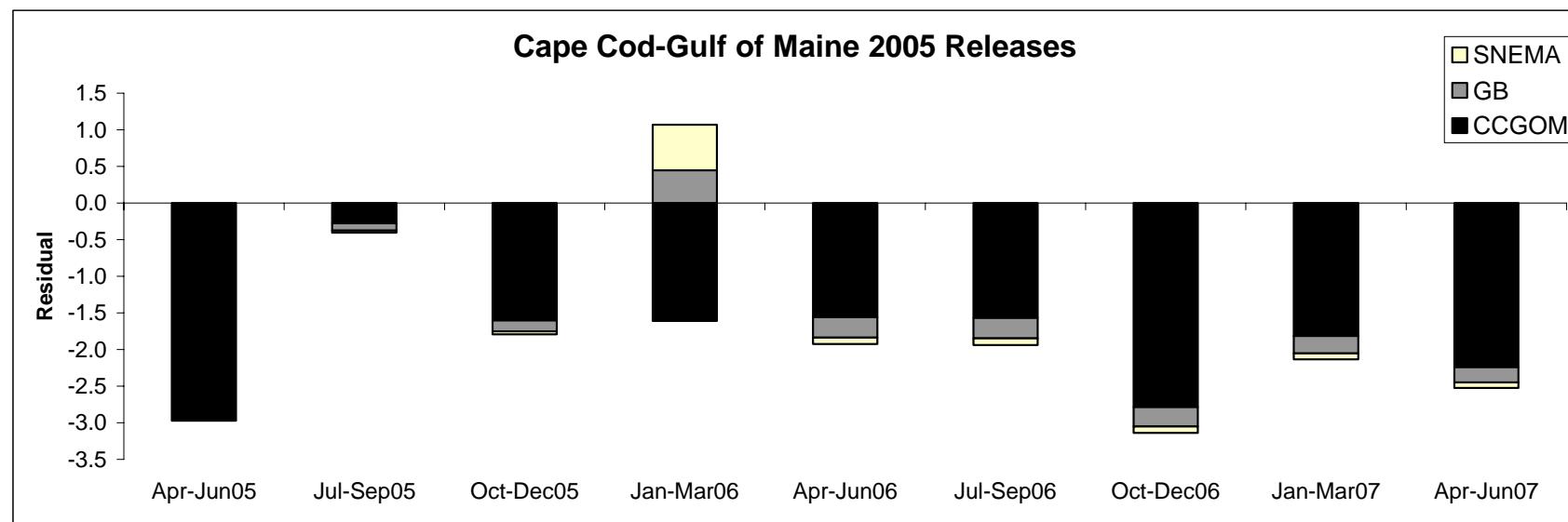
Month	Releases	Mean Date	Recaptures					Predicted Tags at Large				Predicted Recaptures				Residuals			
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total
Apr-Jun04	1689	46	2	5	6	1	14	0	0	1689	1689	0	0	91	91	1	2	-3	0
Jul-Sep04	30	69	1	1	3	0	5	3	6	1466	1475	0	1	148	149	0	0	-4	-3
Oct-Dec04			0	0	6	0	6	5	10	1167	1182	1	1	118	120	0	-1	-3	-4
Jan-Mar05			1	9	1	0	11	6	12	909	927	1	2	92	94	0	1	-4	-2
Apr-Jun05			1	7	2	0	10	6	12	708	726	1	2	71	74	0	1	-3	-2
Jul-Sep05			2	2	1	1	6	6	11	551	569	1	2	56	58	1	0	-3	-3
Oct-Dec05			0	9	1	1	11	6	10	428	444	1	1	43	45	-1	1	-3	-2
Jan-Mar06			0	3	1	0	4	5	9	332	346	1	1	33	35	0	1	-3	-3
Apr-Jun06			1	0	1	0	2	5	8	258	270	1	1	26	28	0	-1	-3	-3
Jul-Sep06			1	1	2	0	4	4	6	201	212	0	1	20	22	0	0	-2	-2
Oct-Dec06			0	0	0	0	0	3	5	157	165	0	1	16	17	0	-1	-3	-4
Jan-Mar07			0	1	0	0	1	3	4	122	129	0	1	12	13	0	0	-3	-3
Apr-Jun07			0	1	0	0	1	2	4	95	101	0	1	10	10	0	0	-2	-2
unknown																			
Total	1719							9	39	24	3	75				7	14	736	757
																1	5	-38	-32



Release Event: Cape Cod-Gulf of Maine 2005

RSS 36.0
RMS 1.3

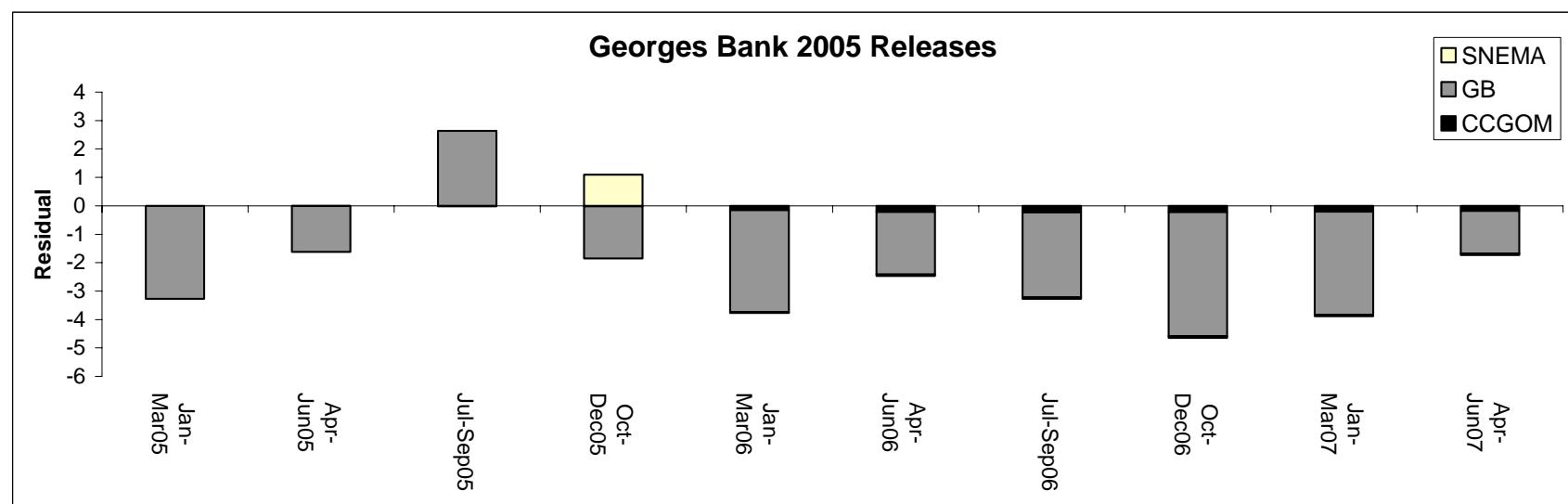
Month	Releases	Mean Date	Recaptures					Predicted Tags at Large					Predicted Recaptures					Residuals				
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total			
Apr-Jun05	548	80	2	0	0	0	2	548	0	0	548	58	0	0	58	-3	0	0	0	-3		
Jul-Sep05	557	23	38	0	0	2	40	429	1	0	430	50	0	0	50	0	0	0	0	0		
Oct-Dec05			19	0	0	1	20	839	1	0	840	98	0	0	99	-2	0	0	0	-2		
Jan-Mar06			14	1	1	0	16	632	2	1	635	74	0	0	75	-2	0	1	0	-1		
Apr-Jun06			11	0	0	1	12	478	2	1	481	56	0	0	56	-2	0	0	0	-2		
Jul-Sep06			8	0	0	2	10	359	2	1	362	42	0	0	43	-2	0	0	0	-2		
Oct-Dec06			1	0	0	1	2	268	2	1	271	31	0	0	32	-3	0	0	0	-3		
Jan-Mar07			3	0	0	0	3	201	2	1	204	24	0	0	24	-2	0	0	0	-2		
Apr-Jun07			1	0	0	0	1	152	2	1	154	18	0	0	18	-2	0	0	0	-3		
unknown			0																			
Total	1105		97	1	1	7	106					452	2	1	454	-16	-1	0	0	-17		



Release Event: Georges Bank 2005

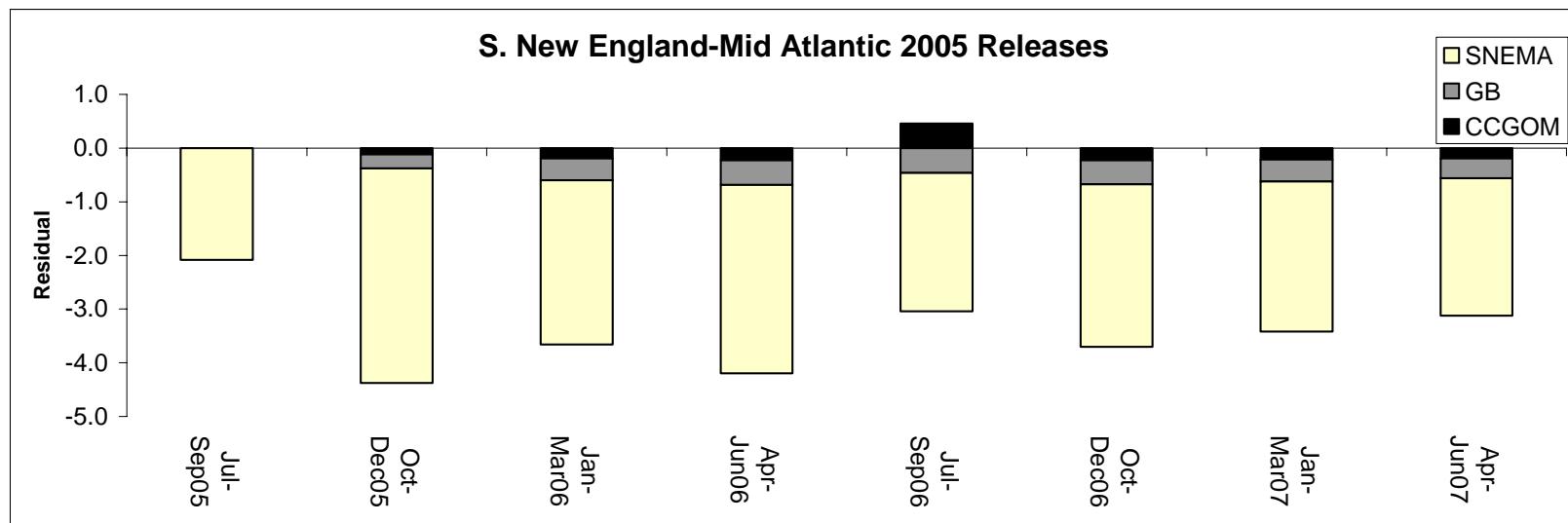
RSS
86.2
RMS
2.9

Month	Releases	Mean Date	Recaptures					Predicted Tags at Large					Predicted Recaptures					Residuals			
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total		
Jan-Mar05	245	62	0	0	0	0	0	0	245	0	245	0	25	0	25	0	-3	0	-3		
Apr-Jun05			0	5	0	0	5	0	202	0	202	0	29	0	29	0	-2	0	-2		
Jul-Sep05	4345	14	0	302	0	11	313	0	145	0	145	0	21	0	21	0	3	0	3		
Oct-Dec05			0	95	2	2	99	0	4206	0	4206	0	602	0	602	0	-2	1	-1		
Jan-Mar06			0	11	0	2	13	1	3002	0	3004	0	430	0	430	0	-4	0	-4		
Apr-Jun06			0	33	0	2	35	2	2141	1	2144	0	307	0	307	0	-2	0	-2		
Jul-Sep06			0	10	0	0	10	2	1527	1	1529	0	219	0	219	0	-3	0	-3		
Oct-Dec06			0	1	0	0	1	2	1091	1	1093	0	156	0	156	0	-4	0	-5		
Jan-Mar07			0	2	0	0	2	2	779	1	782	0	112	0	112	0	-4	0	-4		
Apr-Jun07			0	17	0	0	17	2	557	0	559	0	80	0	80	0	-2	0	-2		
unknown				0																	
Total	4590		0	476	2	17	495					1	1979	0	1981	-1	-22	1	-23		



Release Event: S. New England-Mid Atlantic 2005

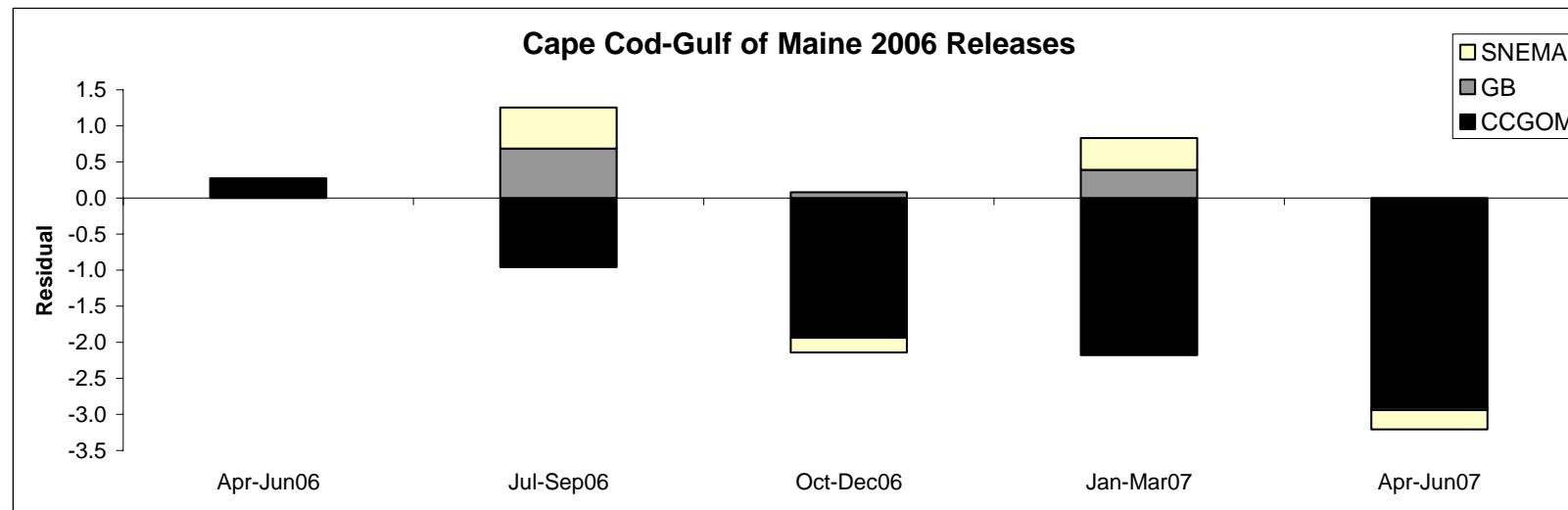
Month	Releases	Mean Date	Recaptures					Predicted Tags at Large					Predicted Recaptures				Residuals				RSS RMS		
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total				
Jul-Sep05	547	10	0	0	0	0	0	0	0	547	547	0	0	7	7	0	0	-2	-2				
Oct-Dec05			0	0	0	0	0	1	2	530	533	0	0	53	54	0	0	-4	-4				
Jan-Mar06			0	0	1	0	1	2	4	413	418	0	1	42	42	0	0	-3	-4				
Apr-Jun06			0	0	0	0	0	2	4	321	328	0	1	32	33	0	0	-4	-4				
Jul-Sep06			1	0	1	0	2	2	4	250	257	0	1	25	26	0	0	-3	-3				
Oct-Dec06			0	0	0	0	0	2	4	195	201	0	1	20	20	0	0	-3	-4				
Jan-Mar07			0	0	0	0	0	2	4	152	158	0	1	15	16	0	0	-3	-3				
Apr-Jun07			0	0	0	0	0	2	3	118	123	0	0	12	13	0	0	-3	-3				
unknown							0																
Total	547						1	0	2	0	3					2	3	207	212	-1	-3	-24	-27



Release Event: Cape Cod-Gulf of Maine 2006

RSS
RMS
19.2
1.3

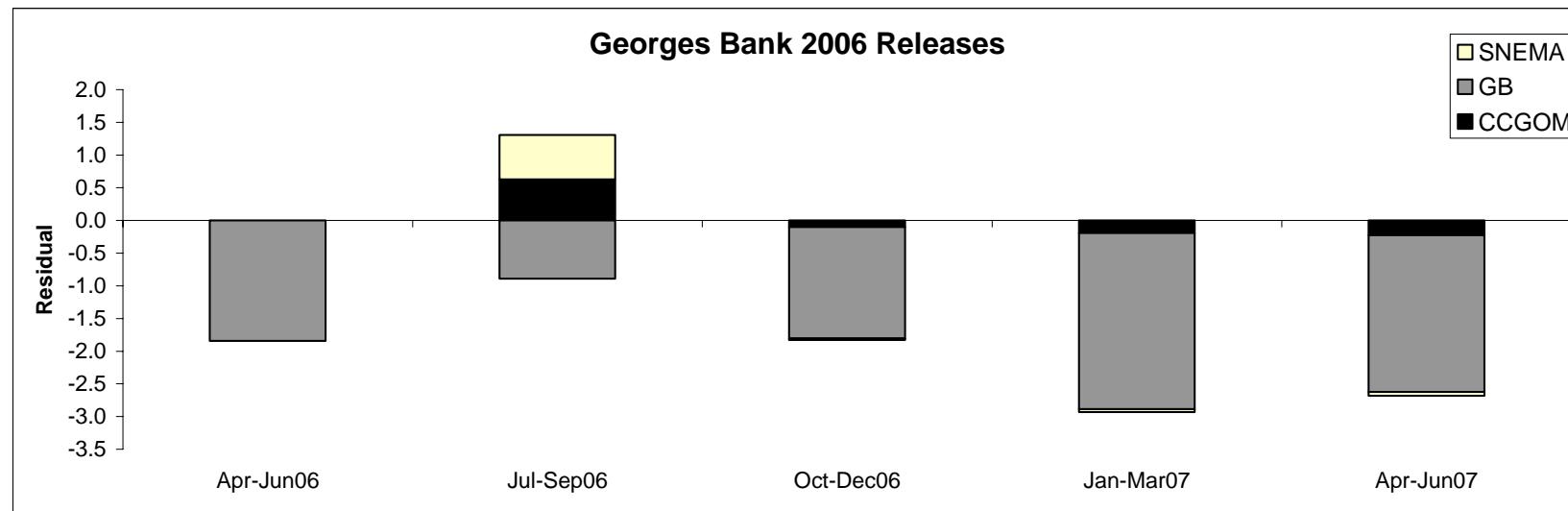
Month	Releases	Mean Date	Recaptures					Predicted Tags at Large				Predicted Recaptures				Residuals			
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total
Apr-Jun06	2617	20	100	0	0	0	100	2617	0	0	2617	76	0	0	76	0	0	0	0
Jul-Sep06	325	2	110	2	1	0	113	2460	4	1	2465	289	1	0	289	-1	1	1	0
Oct-Dec06			36	1	0	0	37	2182	6	2	2190	256	1	0	257	-2	0	0	-2
Jan-Mar07			21	2	1	0	24	1649	7	3	1659	193	1	0	195	-2	0	0	-1
Apr-Jun07			7	1	0	0	8	1246	7	3	1256	146	1	0	148	-3	0	0	-3
unknown							0												
Total	2942		274	6	2	0	282					960	3	1	965	-8	1	1	-6



Release Event: Georges Bank 2006

RSS 21.0
RMS 1.4

Month	Releases	Mean Date	Recaptures					Predicted Tags at Large					Predicted Recaptures					Residuals				
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total			
Apr-Jun06	1859	79	0	37	0	0	37	0	1859	0	1859	0	239	0	239	0	-2	0	-2	0	-2	
Jul-Sep06	2892	33	1	85	1	0	87	1	1456	0	1457	0	208	0	209	1	-1	1	0	0	-2	
Oct-Dec06			0	93	0	0	93	1	3600	0	3601	0	515	0	515	0	-2	0	0	0	-2	
Jan-Mar07			0	24	0	0	24	2	2572	0	2574	0	368	0	368	0	-3	0	0	0	-3	
Apr-Jun07			0	23	0	0	23	2	1838	1	1840	0	263	0	263	0	-2	0	0	0	-3	
unknown							0															
Total	4751		1	262	1	0	264					1	1594	0	1594	0	-10	1	-9	0	-2	



Release Event: S. New England - Mid Atlantic 2006

RSS
84.2
RMS
5.6

Month	Releases	Mean Date	Recaptures					Predicted Tags at Large					Predicted Recaptures					Residuals				
			CCGOM	GB	SNEMA	Unknown	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total	CCGOM	GB	SNEMA	Total			
Apr-Jun06	1082	68	0	0	0	0	0	0	0	1082	1082	0	0	85	85	0	0	-4	-4			
Jul-Sep06	709	18	1	2	4	0	7	2	4	877	883	0	1	88	89	0	1	-3	-2			
Oct-Dec06	0		0	1	1	0	2	3	6	1359	1368	0	1	137	138	0	0	-4	-5			
Jan-Mar07	0		0	0	1	1	2	5	10	1058	1073	1	1	107	109	0	-1	-4	-5			
Apr-Jun07	0		1	0	0	0	1	6	11	823	840	1	2	83	85	0	-1	-4	-5			
unknown			0									2	4	500	507	0	-1	-20	-21			
Total	1791		2	3	6	1	12															

